

years, further expansion in the scale of 3D printing applications in construction is expected, along with its integration with other innovative technologies, such as artificial intelligence and robotics.

References:

1. 3D Concrete Printing Technology: Configuration with Green and Self-Healing Concrete / Tejwant S. Brar, Mohammad A. Kamal, Shubham Singh. Materials Research Forum LLC, 2022. 96 p.

2. 3D Concrete Printing Technology: Construction and Building Applications / Jay G. Sanjayan, Ali Nazari, Behzad Nematollahi. Butterworth-Heinemann, 2019. 448 p.

IMPROVEMENT OF EQUIPMENT FOR MIXING BULK MATERIALS

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Mixing bulk materials is one of the key processes in various industries, including food, chemical, construction, and pharmaceutical sectors. Efficient mixing directly affects the quality of the final product, reduces production costs, and minimizes waste. The challenge of improving mixing equipment lies in achieving uniform mixing, reducing energy consumption, and enhancing ergonomics.

Modern mixing equipment does not always meet the growing demands for efficiency and quality. The main issues include:

- Outdated designs of mixing elements, which do not sufficiently account for the physico-mechanical properties of bulk materials (e.g., granulometry, density, caking behavior).
- Low energy efficiency, leading to increased production costs.
- Difficulties in handling multicomponent materials, particularly those with significant differences in properties (particle size, density, flowability).
- High wear rates of equipment, causing frequent downtimes and increased maintenance costs.

Beyond technical challenges, increasing requirements for environmental sustainability and energy efficiency play a crucial role. The implementation of innovative solutions in mixing equipment can:

- Reduce energy consumption and lower the carbon footprint of production.
- Minimize material losses due to uneven mixing or material adhesion to mixing elements.

- Ensure consistent product quality, allowing manufacturers to better meet consumer demands.

Types of Industrial Mixers

The main types of mixers used in industrial applications include:

- Gravity mixers (screw, drum).
- Mechanical mixers with moving elements.
- Pneumatic mixers.

The advantages and disadvantages of each type of equipment are discussed in studies [1, 2]. Particular emphasis is placed on selecting the optimal design based on the physical properties of the mixed materials (bulk density, particle shape, moisture content).

Innovative Approaches to Equipment Improvement

Modern approaches to improving mixing equipment focus on the following aspects:

- Implementation of intelligent control systems for real-time process monitoring [3].
- Development of new mixing chamber geometries to reduce material stagnation zones [4].
- Application of hybrid mixers, combining mechanical and pneumatic mixing to enhance efficiency [5].

According to research [6], energy-efficient electric motors and process automation can reduce energy consumption by 10 – 15%. Additionally, reducing noise and dust emissions during equipment operation is essential, which can be achieved through sealing and aspiration systems.

Conclusions. The improvement of mixing equipment for bulk materials is a multifaceted process that encompasses technological, environmental, and economic aspects. The primary directions of improvement include:

- Enhancing mixing uniformity through optimized mixer design and hybrid technologies.
- Reducing energy consumption via energy-efficient electric motors and automation systems.
- Minimizing environmental impact by sealing equipment and using aspiration systems, improving ecological sustainability and workplace safety.
- Developing advanced mixer designs with novel geometries and modular configurations to enhance cost efficiency, reduce maintenance costs, and expand application areas.

Future research should focus on adapting mixers to new materials, improving mixing precision, and developing universal mixers for various industries. These measures will enhance product competitiveness, improve production efficiency, and contribute to environmental sustainability.

References:

1. Bondarenko V. I. *Technology of Bulk Material Mixing*. – Kyiv: Naukova Dumka, 2018.
2. Smith J., Lee D. *Mixing Technologies in the Process Industry*. – Springer, 2020.

3. Green R. *Advances in Bulk Material Handling*. – Elsevier, 2021.
4. Kovalenko P. Yu. *Automation of Bulk Material Mixing Processes*. – Kharkiv: KhNTU, 2019.
5. Wagner S. *Hybrid Mixing Equipment for Industrial Use*. – Wiley, 2021.
6. Ivanov O. *Energy-Efficient Mixing Technologies*. – Cambridge University Press, 2022.

AFTER WAR RESTORATION OF CONSTRUCTION INDUSTRY

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The Ukrainian construction economy is slowly thriving, with a noticeable restoration because of the revival of facilities damaged by shelling. Nowadays, there is no time or facilities for the implementation of restoration projects. Works on the construction of fortification structures are more preferable and underway.

Ukraine has been in a state of full-scale war with the Russian Federation for the fourth year in a row, which significantly affects any industry, including the construction industry. The hostilities caused serious changes in the economic and socio-cultural sphere in all regions of the country. In this context, the construction industry is also going through great transformations and challenges that are worth studying and understanding.

We have identified ten key trends in the construction industry that have emerged during martial law and that need to be taken into account when developing strategies that will help enterprises in this industry effectively respond to the challenges they face.

1. Reduction of the domestic market for building materials With the beginning of the full-scale invasion, most Ukrainian enterprises were forced to suspend or limit production, and some refocused on the needs of the Armed Forces of Ukraine. Many construction enterprises and infrastructure facilities have been damaged or destroyed, many enterprises in the South and East have found themselves in the territories of active hostilities or under temporary occupation, as well as logistics elements, suppliers of raw materials and components. The energy crisis, in particular damage to engineering infrastructure, also negatively affected the production of construction products. The industry experienced an acute shortage of raw materials and building materials – glass, hardware, building mixtures, bricks, etc.

2. Problems of importing building materials. A large share of raw materials and building materials has to be imported, but the volume of imports is also limited, since the port infrastructure practically does not work. Although during martial law, the government adopted a number of resolutions to simplify the import of certain goods, many building materials were still not included in the lists. There is also import substitution and restructuring of logistics links after the rejection of